



Research paper

Survey of over 4, 500 monumental olive trees preserved on-farm in the northeast Iberian Peninsula, their genotyping and characterization

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ABSTRACT

Inventorying, characterising and conserving on-farm ancient olive trees is a priority for safeguarding their genetic, natural and agricultural value and for protecting ancient genotypes threatened with extinction. In the “Taula del Sénia” (M-TdS) area (northeast Iberian Peninsula) a highly important cultural landscape has been preserved, in which the olive groves play an outstanding social and economic role: the ancient olive trees, sustained by many local farmers, constitute a living heritage and provide a clear example of High Nature Value (HNV). A total of 4526 ancient productive olive trees, with a trunk circumference (PBH) larger than 3.5 m, were inventoried and their spatial localization and biometric measurements were collected. 41 olive trees have shown the highest category in monumentality (PBH > 8.1 m). The endocarp morphology of a representative sample of the most ancient trees from this settlement resulted in 14 different profiles. The ancient trees genotyped, through eight simple sequence repeat (SSR) markers, revealed 43 SSR profiles. The use of SSR enabled us to verify that most of the trees (98%) belong to the local cv. ‘Farga’, a male sterile variety with a rare chlorotype, only a few trees corresponded with other local varieties, ‘Morrut’, ‘Canetera’ and ‘Sevillena’, and ten hitherto unidentified genotypes were distinguished, some with chloroplast lineages different from the ‘Farga’ type. The M-TdS area holds a unique living and exploitable heritage with the highest concentration of ancient olive trees worldwide. On-farm conservation of this germplasm by the community of local growers is enabling preservation of this important source of genetic variation, potentially holding traits of resilience and adaptation to adverse soil and climatic conditions, demonstrated by the survival of these trees over the centuries. Farmers have undertaken initiatives to valorize the olive oil deriving from these M-TdS trees.

1. Introduction

The olive tree (*Olea europaea* L.) is a long-lived fruit tree species considered a reliable indicator of the Mediterranean environment (Moriondo et al., 2013; Vargas and Kadereit, 2001). Recent studies have identified ancient olive trees, including both cultivated and wild forms, in several Mediterranean countries as Italy (Baldoni et al., 2006; Cicatelli et al., 2013; Erre et al., 2010; Salimonti et al., 2013), Greece (Cherubini et al., 2013; Maravelakis et al., 2013; Michelakis 2002), Montenegro (Lazović et al., 2016), Israel and the Palestinian territories (Barazani et al., 2014; Petruccelli et al., 2014), and even in Western Asia (Iran) (Mousavi et al., 2014). These trees testify to the antiquity of

olive growing throughout the Mediterranean region, as well as their long lifespan and ability to survive under adverse conditions (Baldoni et al., 2006).

There are archaeological evidences of olive cultivation in the Iberian Peninsula since Neolithic and Chalcolithic times (Buxó 1997; Terral et al., 2004) and of its extension during the Bronze Age. In Spain, the main expansion was during the Roman period (Buxó 2005; Rodríguez-Ariza and Montes, 2010; Terral and Arnold-Simard 1996), as confirmed by the proliferation of oil extraction structures (Rodríguez-Ariza and Montes, 2005).

Spain is currently the world's major olive oil producer (Nations FAO, 2014) and still preserves a rich olive genetic heritage, as shown by the

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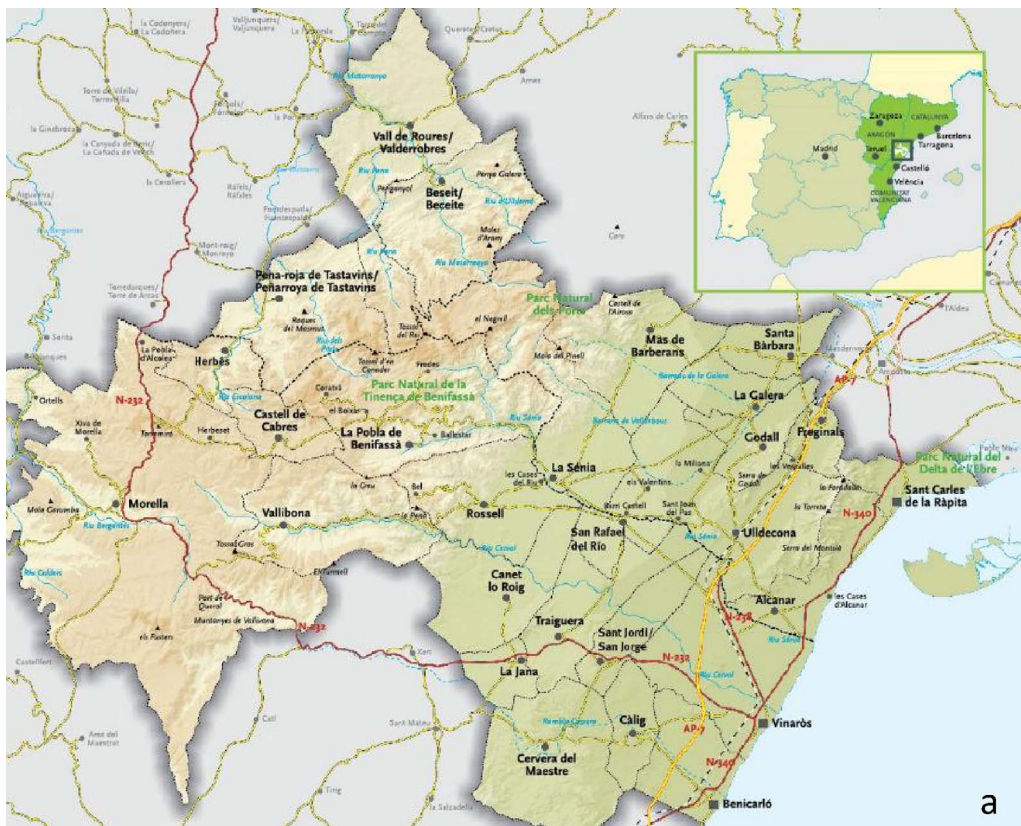


Fig. 1. Geographic area of prospecting in the north-east of the Iberian Peninsula (a) and distribution of the ancient monumental olive trees (b).



large number of olive varieties cultivated in different regions (Belaj et al., 2004c; Belaj et al., 2010; Rallo et al., 2005). The presence of centennial trees (Díez et al., 2004; Díez et al., 2011) and wild olive forests (Belaj et al., 2007; Belaj et al., 2010; Belaj et al., 2011) have also been reported. The M-TdS area under investigation is one of the few zones which still has retained a large local olive patrimony, probably originating from the initial introduction of ancestral varieties, followed by their cross breeding and empirical selection (Barranco and Rallo

2000). Although Andalusia, in southern Spain, is the main olive producing region, with more than 1.45 Mha (MAGRAMA, 2014), olive growing is also one of the most important agricultural activities in northeastern Spain (Catalonia, Valencia and Aragón regions), with seven protected denominations of origin (PDO) and a large number of local varieties. They are still cultivated and preserved, both in *ex situ* regional collections (Paz et al., 2005; Tous et al., 2005) and at the World Olive Collection in Córdoba (Belaj et al., 2012), attesting to the

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